RESERVE COPY

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,133,098

1,133,098

Date of filing Complete Specification: 16 Feb., 1966.

Application Date: 20 Nov, 1964. No. 47277/64.

Complete Specification Published: 6 Nov, 1968.

© Crown Copyright 1968.

Index at acceptance: —F4 G(1Q3, 2B1A2, 23)

Int. Cl.: —F 26 b 9/00

COMPLETE SPECIFICATION

Improvements in and relating to Drying Apparatus

I, JOHN EDWARD RANDELL, of 27, Ennisdale Drive, West Kirby, Wirral, Cheshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to drying apparatus which may be used both domestically and industrially.

Many types of drying apparatus exist and many different principles of operation have been incorporated in their design. One type removes the moisture content of a mass of wet articles by rotating the mass at high speed and such a drier is commonly referred to as a spin drier. It is not possible however, to remove all the water contained in the articles by this method.

Another type of dryer relies for its drying action on the evaporation of the water contained in the articles, by raising the temperature within an enclosure containing the articles. It is possible to achieve complete dryness by this method, but in order to dispose of the steam and still maintain the temperature within the enclosure, a large heating unit is necessary which results in a high level of power consumption.

A still further type of drier continually agitates the articles whilst simultaneously causing hot air to flow continuously through them. This type of drier however is very uneconomical in operation and there is also a considerable risk of damage to the articles during the drying process.

According to the present invention drying apparatus comprises a first chamber containing air heating means, a second chamber containing air cooling means, a third chamber adapted to receive articles to be dried, passage means connecting the three chambers, air displacement means for continuously displacing air during drying from the heating chamber into the drying chamber, means for directing air from the drying chamber to the cooling chamber for recirculating to the heating chamber and means for by-passing the cooling chamber to permit a proportion of the air to be recirculated without being cooled.

Preferably some or all of the walls of the chambers are formed from material of high thermal resistivity, the air heating and air cooling means comprise a condenser and evaporator respectively of a refrigeration plant, and the air displacement means comprises a motor-driven fan arrangement. Collector and disposal means for collecting and disposing of the water condensate in the cooling chamber is conveniently included and one arrangement comprises a 'V'-shaped trough located directly below the evaporator, having a drain-hole and drain pipe at one end.

In a preferred embodiment of the invention the three chambers are contained within a single enclosure and the refrigeration plant is a vapour compression system wherein the compressor is contained at least in part within the heating chamber and the recirculating air is additionally heated by passing it over the compressor. The air may be further heated by additional air heating means such as an electric heating element, mounted in the heating chamber.

Conveniently the compressor and the fan are both driven from the same motor which for domestic applications is preferably an electric motor.

In a further embodiment of the invention automatically controlled switching means is included, adapted to switch off the refrigeration plant and any additional heating means, after certain conditions, for example associated with the temperature or humidity of the air in or leaving the drying chamber, have been reached. The fan may be switched off at the

[Price

SEE ERRATA SLIP ATTACHED

Price SPECIFICATION AMENDED - SEE ATTACHED SLIP

same time or after the elapse of a period of time. Conveniently the switching means is controlled by a humidistat mounted within the drying chamber or in an airstream taken from the drying chamber or in the airstream passing through the heating chamber.

Alternatively the switching means may be controlled by a time delay mechanism or by a thermostat attached to the evaporator or in the airstream leaving the evaporator or by a mechanism operated by either the pressure difference between the evaporator and condenser or temperature difference between the evaporator and condenser. In addition or alternatively, the controlling device may alter the air flow volume over the evaporator.

Articles to be dried may be supported in the drying chamber in various different ways. In an embodiment for use as a domestic clothes drier the suporting means comprises a plurality of shelves mounted horizontally inside the drying chamber on which the articles may be placed.

In another domestic embodiment the supporting means comprises a framework adapted to fit within the drying chamber wherein a plurality of slats or rails are supported at their ends on side members of the framework and are mounted in horizontal planes across the framework, the ends of each slat being adapted to fit into grooves or channels formed in the side members whereby the slats are slidable in a lateral manner relative to one another and the framework.

In another preferred embodiment means is provided to vary the proportion of the air which flows from the drying chamber to the heating chamber through the cooling chamber.

The invention will now be described further by way of example with reference to the drawings accompanying the Provisional Specification, in which:—

Fig. 1 is a diagrammatic view of a domestic drier embodying the invention,

Fig. 2 is a perspective view of the drier of Fig. 1 with parts cut away for clarity,

Fig. 3 is a perspective view of a support means for supporting clothes in the drier of Fig. 1, and

Fig. 4 is an enlarged, sectional view of one end of a supporting member illustrating the method of mounting. — and the accompanying drawing which illustrates schematically alternative arrangements of a drier embodying the invention.

A drier generally designated 10 comprises an air heating chamber 12, an air cooling chamber 14 and a drying chamber 16. An air duct 18, is situated substantially underneath the chambers 12, 14 and 16, and serves to connect the drying chamber 16 and the cooling chamber 14 with a fan 20 and the heating chamber 12. A compression refrigeration system is mounted within the drier, the compressor 22, being contained within the duct 18, the condenser 24, in the heating chamber 12 and the evaporator 26 in the cooling chamber 14. A V-shaped trough 28 positioned directly below the evaporator 26 cooperates with a drain-pipe 30 to collect and dispose of water condensed from the air in the cooling chamber 14.

In operation air from the fan 20 is deflected by a baffle 32 into the heating chamber 12. It is subsequently displaced from the heating chamber 12 into the drying chamber 16, and distributed over the entire area of the drying chamber 16 by a series of parallel spaced baffles 34.

Damp clothes are placed on a framework (not shown) located within the drying chamber, and the heated air moves down through the clothes picking-up moisture as it goes to the lower part of the chamber 16, where the majority of it is drawn through apertures 36 in a partition 44 into the duct 18, where after passing over the compressor 22 it is recirculated by the fan 20. Some of the air however, is drawn into the space between a vertical partition 38 and a vertical partition 40, and after rising between these two partitions it is displaced into the cooling chamber 14, where it moves down over the evaporator 26 and is drawn into the duct 18 through apertures 42 in the lower portion of the partitions 40, where it joins the original stream of air and after passing over the compressor unit 22 is recirculated by the fan 20.

Fig. 2 illustrates the constructional features of one embodiment of the invention and where applicable the reference numerals are the same as those used in Fig. 1.

A door 46 fitted to one wall of the drier co-operates with an opening in that wall so that the drying chamber 16 is totally enclosed when the door 46 is closed and is accessible through the opening in the drier wall when the door 46 is open.

The walls of the drier conveniently include one or more layers of thermal insulating material sandwiched between outer and inner surface skins of wood or plastics material or sheet metal. The thermal insulating material may be any of various materials, but is preferably a foam plastic material, such as expanded polystyrene or cork.

Fig. 3 illustrates a means for supporting articles in the drying chamber 16, which comprises a framework 50 adapted to be removably fitted into the drying chamber 16 and a plurality of rails 52 mounted on side-members 54 of the framework 50. The ends of the rails 52 are each fitted with a projection 56 as illustrated in Fig. 4, which is adapted to fit in the channel 58 formed in the top surface of each side piece 54 so that when the framework 50 is mounted in the drying chamber 16 and is being loaded with clothes the rails 52 may be moved in a lateral manner

relative to one another and to the framework 50.

As will be most readily seen from Fig. 1 of the drawings, some of the air displaced from the drying chamber 16 passes through the apertures 36 while the remainder passes up between the partitions 38 and 40 into the cooling chamber 14. By altering the size of the apertures 36 or of the apertures 42 or the spacing between the partitions 38, 40 or any combination thereof, it is possible to vary the quantity of air which flows directly to the duct 18 relative to the quantity of air which flows to the cooling chamber 14. This adjustment may be made during manufacture or means may be provided to adjust the size of the apertures or the spacing between the partitions. Such means may for example be controlled in response to changes in the temperature of the air passing the evaporator. In order that the drying process be performed efficiently, the volume of air flowing through the drying chamber must be high. Furthermore, in order to operate the compressor refrigeration system efficiently, the condenser temperature should be minimised, and this is effected most easily with a high volume of air flow.

However it is found that a low air flow volume is required past the evaporator in order that the refrigeration system can be operated under optimum dehumidifying conditions. Consequently the drier will operate most efficiently when the proportion of the air flowing through the apertures 36 greatly exceeds the proportion through the gap between the partitions 38, 40, into the cooling chamber 14, and the relative proportions are preferably varied by appropriate adjustment as described above, until the most efficient mode of operation is achieved.

In Fig. A of the accompanying alternative drying apparatus is illustrated which may be conveniently mounted on a frame as a composite unit which may be inserted within a thermally insulated housing such as a cupboard. The apparatus is preferably mounted on a baseplate 100 which is normally arranged in a substantially horizontal position, within an insulated enclosure 102. A condenser 104 of a vapour compression refrigeration system is mounted above and adjacent an aperture formed at one side of the baseplate, and a fan 106 is mounted below the aperture. A partition 108 upstanding from the central region of the baseplate serves as a dividing wall causing air displaced through the aperture and past the condenser 104 to rise on one side of the enclosure 102 and fall on the other side thereof. The presence of the partition 108 in fact substantially increases the velocity of the air flow through the enclosure as compared with the velocity of the air flow in the apparatus described and illustrated in Figs. 1 and 2, when the same size of fan is used.

The baseplate 100 is arranged to seal the space below from that above the baseplate except for an aperture 110 on the side opposite to that on which the condenser is mounted, the evaporator 112 of the refrigeration system is mounted adjacent this aperture 110 and below the baseplate, and the compressor 114 of the system is arranged below the baseplate between the evaporator 112 and the fan 106. The evaporator 112 is preferably mounted adjacent the aperture 110 so that air flowing from the space within the enclosure 102 above the base plate 100, through the aperture 110 is caused to pass through the evaporator 112 or through a passage 116 between the evaporator 112 and baseplate 100 and the aperture 116 is dimensioned so that the proportions of air flowing through the aperture and evaporator are such that the evaporator is maintained at its most efficient operating temperature.

When used as a domestic clothes drier, the circulating air can easily become contaminated with fluff, usually termed lint. Consequently it is preferable to include filter means in the airstream to collect any such lint, and a fine mesh screen is conveniently arranged within the path of the circulating air, for this purpose. In the embodiment illustrated in Figs. A and B of the accompanying drawing, this screen is designated 118 and is illustrated as being positioned immediately above the baseplate aperture 110 which leads to the evaporator 112.

Fig. B of the accompanying drawings illustrates an alternative arrangement of the evaporator 112 and by-pass arrangement in which the evaporator is mounted substantially parallel with the underside of the baseplate and a tank 120 or other water container is disposed beneath the evaporator. A further aperture 122 is formed in the baseplate and is spaced from the aperture 110 so that the evaporator lies between the two apertures 110 and 122. Air from the space above the baseplate 100 may thereby pass through the aperture 110 or the aperture 122, only the air passing through the former passing over and around the evaporator. By varying the relative sizes of these two apertures so that the proportions of air passing directly to the fan 106 and indirectly thereto, may be varied until the desired proportions are achieved.

In Fig. C of the accompanying drawing a still further alternative arrangement of the evaporator 112 is shown in which only a single aperture 110 is required in the baseplate 100 adjacent the evaporator 112, and the evaporator 112 is mounted in a position beneath the base plate 100 which is substantially similar to that illustrated in Fig. B of the accompanying drawing. A baffle 124 or similar water collector means is arranged beneath the

evaporator 112 and the compressor 114 is conveniently mounted underneath this baffle. Air drawn through the aperture 110 is thereby able to pass to the fan 106 either through the duct formed by the base plate and baffle 110, 124 respectively or through the duct formed by the baffle 124 and the base of the enclosure 102. As will be seen air which passes through the first mentioned duct passes over and around the evaporator 112 whilst the air is drawn through the second mentioned duct is not cooled but is in fact warmed by passing over and around the compressor 114. By varying the position of the baffle 124 relative to the baseplate 100 and the base of the enclosure 102 the proportions of air flowing directly and indirectly to the fan can be altered to give maximum dehumidifying conditions.

WHAT I CLAIM IS:—

1. Drying apparatus comprising a first chamber containing air heating means, a second chamber containing air cooling means, a third chamber adapted to receive articles to be dried, passage means connecting the three chambers, air displacement means for continuously displacing air, during drying from the heating chamber into the drying chamber means for directing air from the drying chamber to the cooling chamber for recirculating to the heating chamber and means for by-passing the cooling chamber to permit a proportion of the air to be recirculated without being cooled.

2. Drying apparatus as claimed in claim 1 wherein the three chambers are contained within a single enclosure.

3. Drying apparatus as claimed in claim 1 or 2 wherein the air heating and cooling means comprise a condenser and evaporator respectively of a refrigeration plant.

4. Drying apparatus as claimed in claim 3 wherein the refrigeration plant is a vapour compression refrigeration system of which the compressor is mounted in the stream of displaced air to provide an additional heating means.

5. Drying apparatus as claimed in claim 4 which comprises further air heating means, such as an electric heating element, mounted in the heating chamber.

6. Drying apparatus as claimed in any of the preceding claims, wherein the air displacement means is a motor driven fan.

7. Drying apparatus as claimed in claim 4 or 5 wherein the air displacement means is a fan, and the compressor and the fan are driven by the same motor.

8. Drying apparatus as claimed in any of the preceding claims which further comprises collector and disposal means for collecting and disposing of water condensate produced in the cooling chamber.

9. Drying apparatus as claimed in any of the preceding claims which further comprises switching means responsive to the temperature or humidity or both of the air within the apparatus and arranged to switch off the heating, cooling and air displacement means when a certain level of temperature or humidity, or both, are reached.

10. Drying apparatus as claimed in any of claims 1 to 8 which further comprises switching means operable by a time delay mechanism.

11. Drying apparatus as claimed in any of the preceding claims which further comprises removable support means on which articles to be dried may be supported within drying chamber.

12. Drying apparatus as claimed in any of claims 2 to 11 wherein the walls of the chambers and the enclosure are formed at least in part from material of high thermal resistivity such as a foam plastic material.

13. Drying apparatus as claimed in any of the preceding claims which includes means for varying the proportion of the air which flows from the drying chamber to the heating chamber without being cooled.

14. Drying apparatus comprising a thermally insulated enclosure, first partition means for defining two separate compartments within the enclosure, air heating means adjacent a first aperture in the partition and air cooling means adjacent a second aperture spaced from the first aperture, and air displacement means disposed in one compartment for displacing air from said one compartment, through the first aperture into the other compartment and past the heating means from said other compartment through the second aperture to return some the air to the air displacement means through the cooling means, the remainder passing to the air displacement means from the second aperture without passing through the cooling means.

15. Drying apparatus as claimed in claim 14 which includes additional partition means dividing said other compartment substantially in half whereby said first aperture lies in one half and the second aperture lies in the other half and at least a further aperture is formed in the additional partition in a region thereof remote from the first partition and the first aperture, whereby air displaced into said one half is caused to pass to a region thereof remote from said first aperture before it can pass into said other half and pass to said second aperture.

16. Drying apparatus constructed and arranged substantially as herein described with reference to and as illustrated in the drawings accompanying the Provisional Specification.

17. Drying apparatus constructed and arranged substantially as herein described with reference to and as illustrated in the accompanying drawing.

W. P. THOMPSON & CO.,
12, Church Street,
Liverpool, 1.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1968.
Published by the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

1133098 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

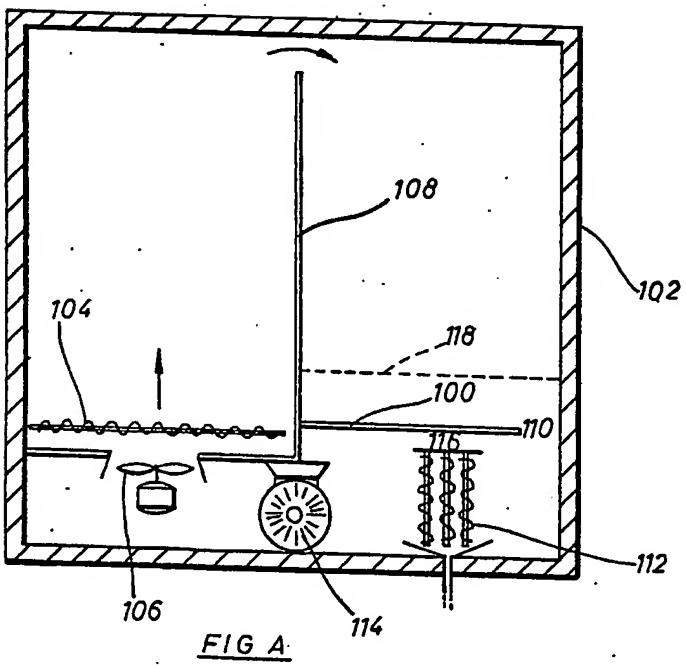


FIG A

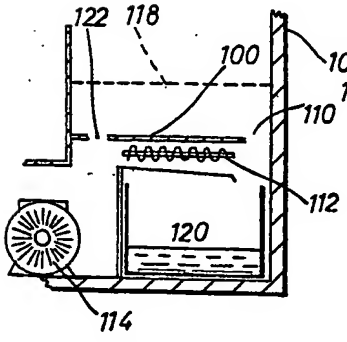


FIG B

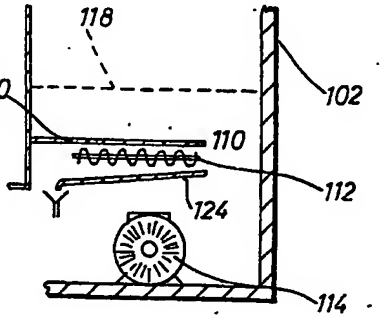


FIG C

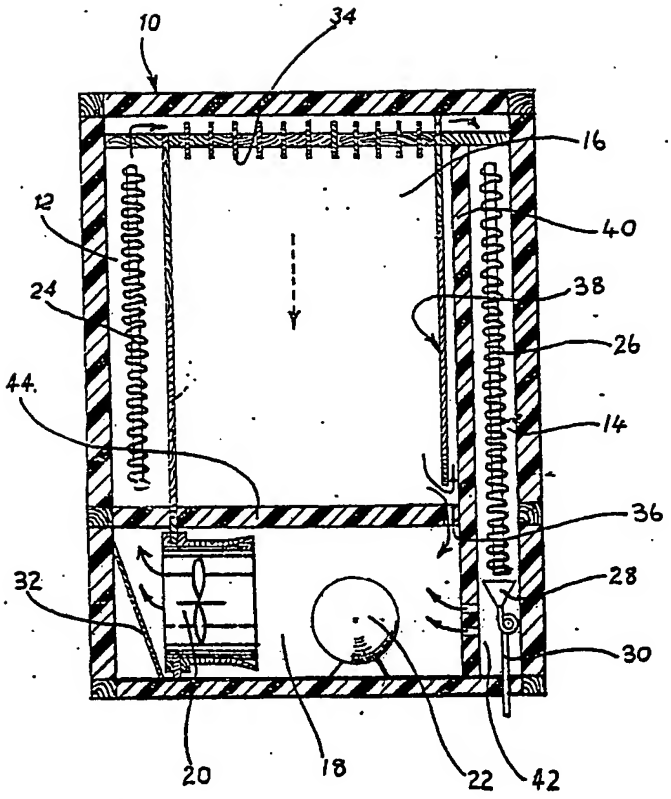
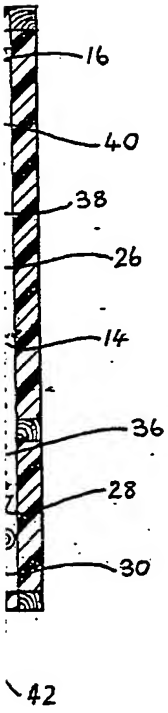


FIG1.

1133098 PROVISIONAL SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2



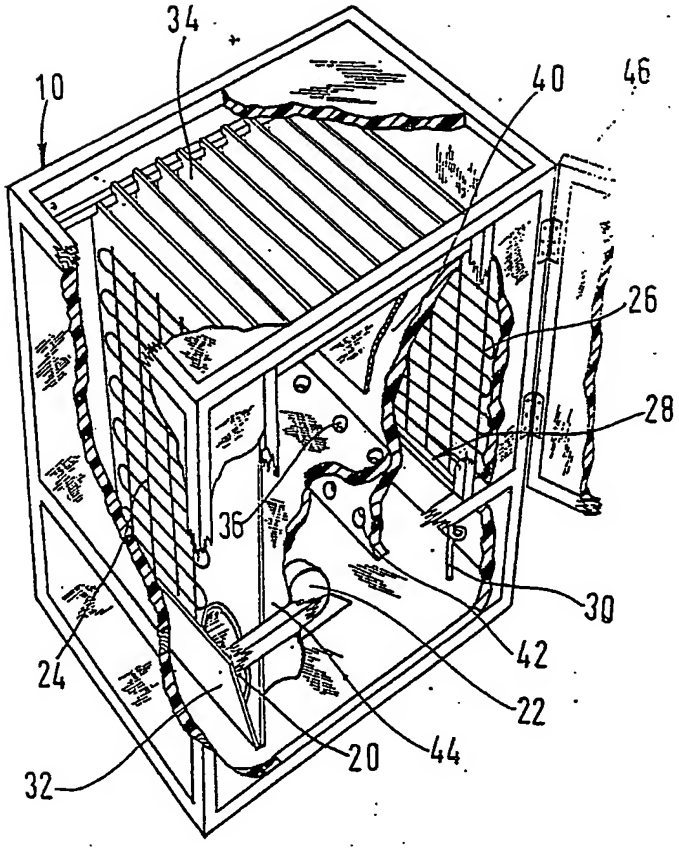


FIG. 2.

1133098 PROVISIONAL SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

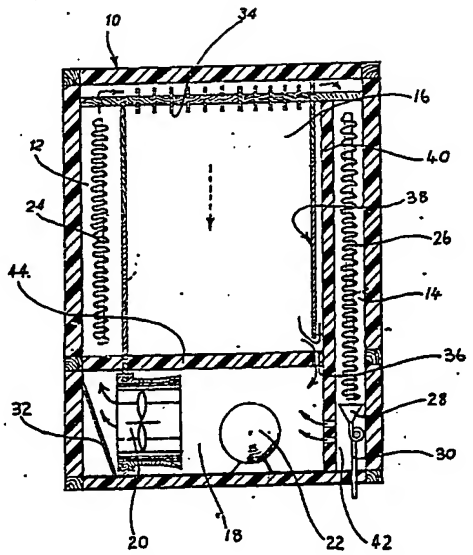


FIG1.

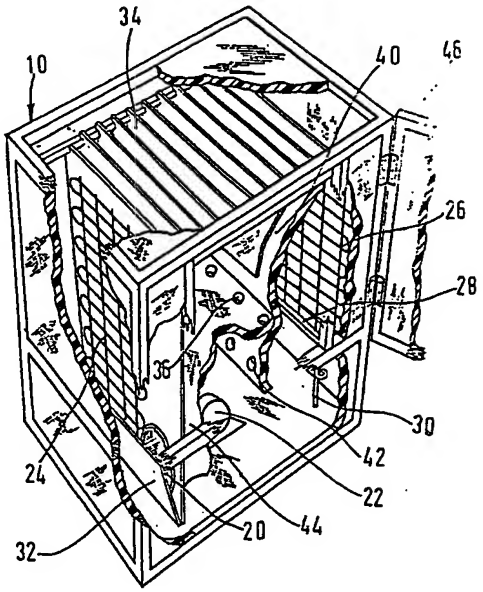


FIG.2.

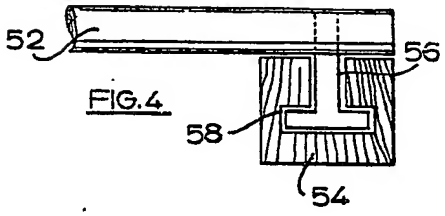


FIG.4

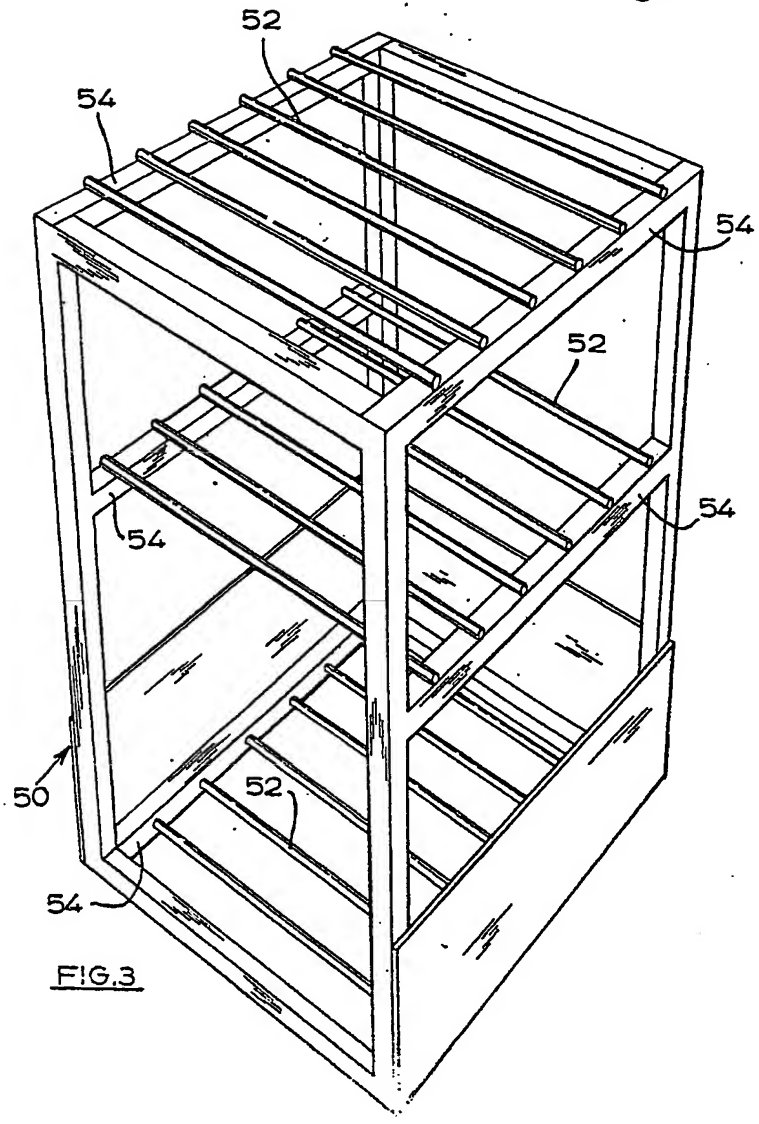


FIG.3